Vertical Plane Ambiguity

- We measure the 2-D projection of the image by further projecting it into 1-D wire readout and then combining these by using time and pattern.

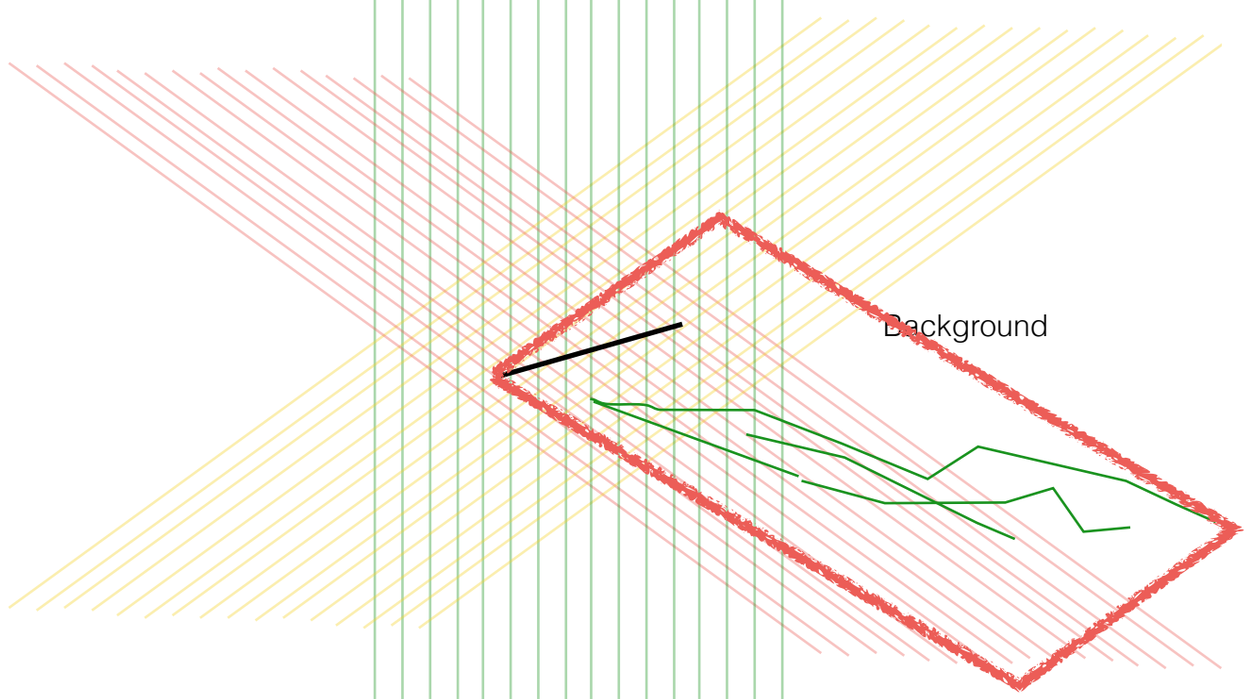
- Vertical plane ambiguity is created when the event is in the vertical plane (parallel to the wire readout) thus not allowing the use of time to associate wires.

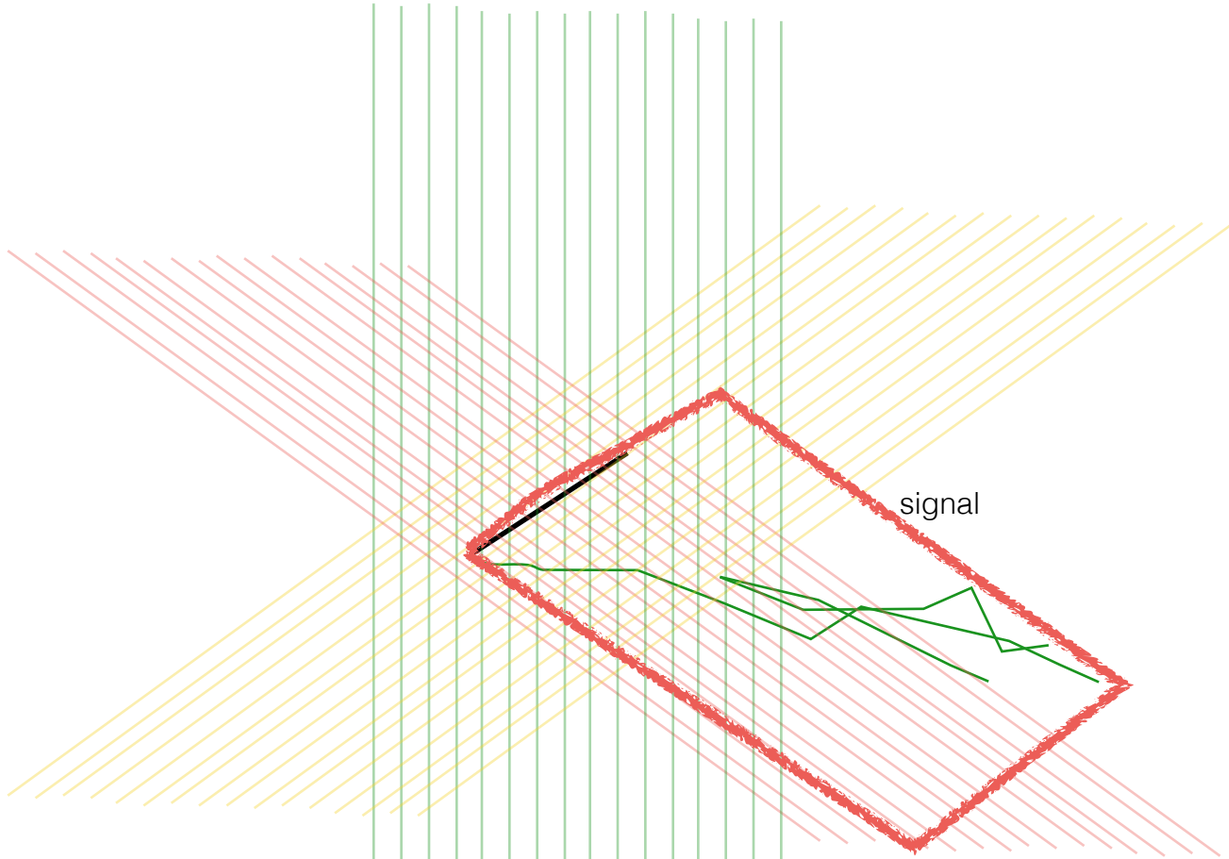
- Due to momentum conservation if a single track is in the vertical plane then another track is also likely to be in the same plane thereby causing further reconstruction errors.

- This is a well-known problem. But we have to confront it now.

Focus only on the golden events first. These have a single shower with a recoiling nucleon(s)

Region of ambiguity





Two essential cuts for background suppression
1) Gap
2) dE/dx

These do not work well if the event is in the vertical plane. The entire event need not be in the vertical plane. Only the first few cm are important.

rad length ~ 14 cm.
Photon mean path ~ 9/7 * 14 = 18 cm
drift v ~ 1.6 mm/microsec.

Require that the gap for 90% of single photon conversions be visible. => gaps of >1.8 cm must be caught.

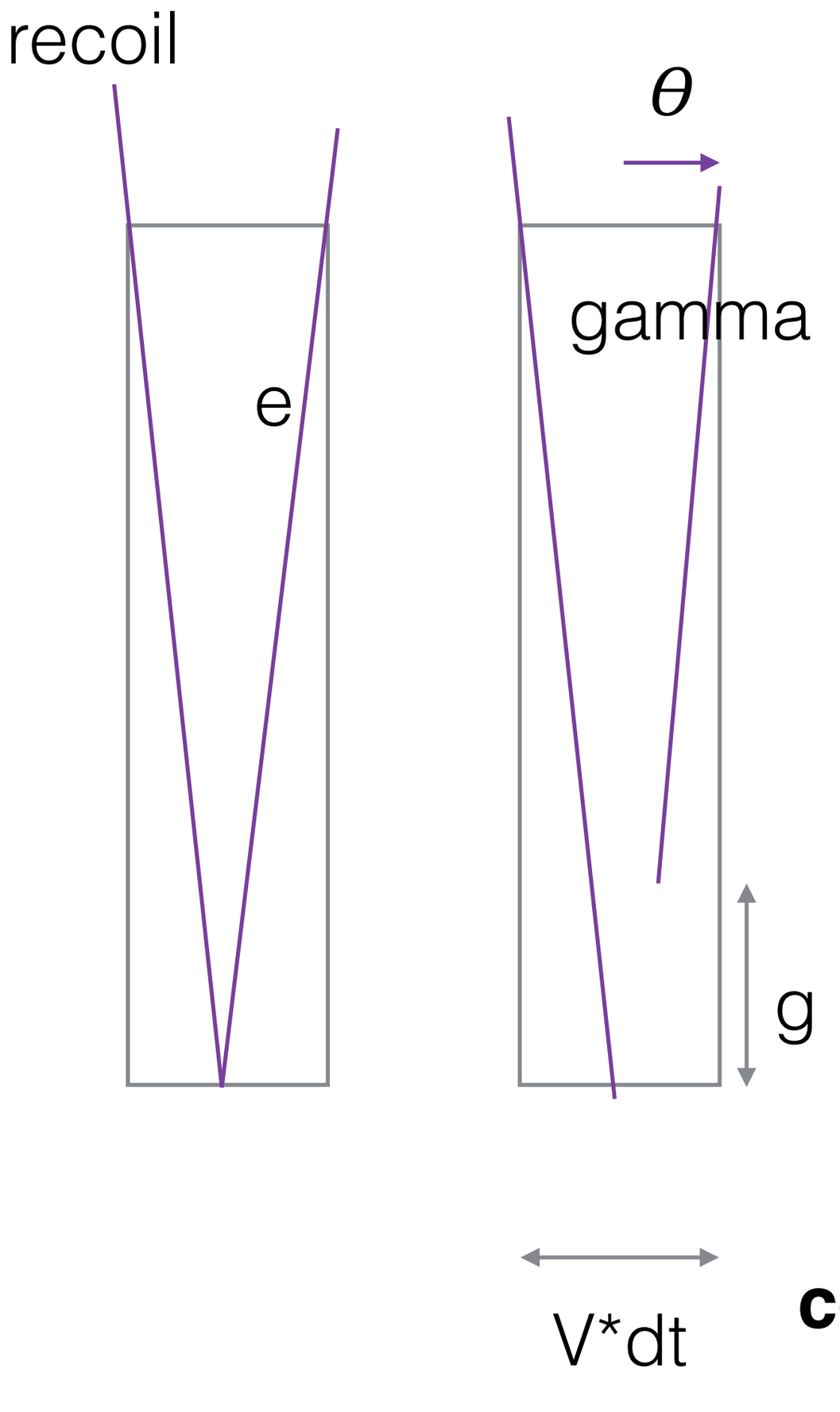
Fraction of events in the vertical plane ambiguity.

- Assume vertical is defined by 3 mm

- Fraction of two track events in the vertical plane as a function of gap length will be ~0.3cm/gap < 0.2.

- Estimate that the number of golden events is ~10-20%. About 20% of these might be affected.

- For multi-track shower events, the situation gets worse since each shower has a ~10-20% chance of being in the VPA.



drift

For g> 2 p

g*θ > V*dT

V = 1.6 mm/μs

dT = 2 μs

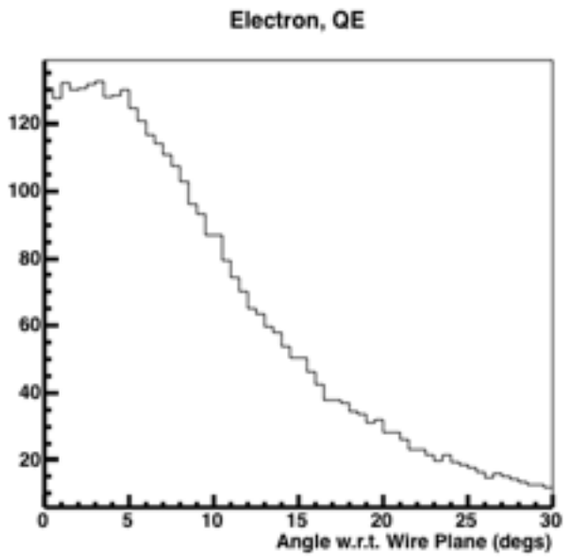
p = 0.5 cm

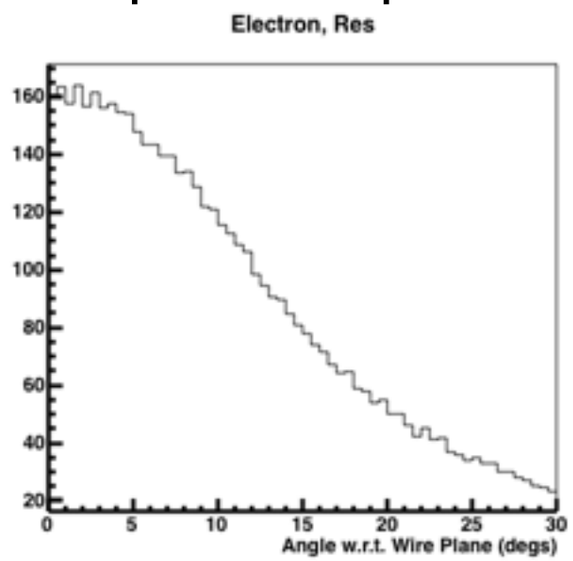
=> θ ~ 0.3

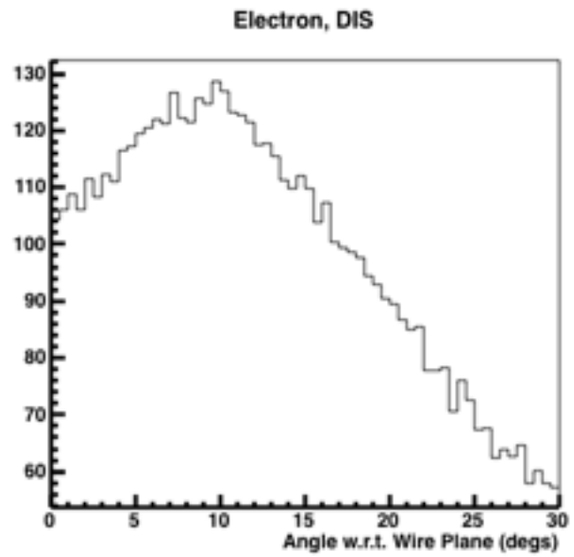
~17 deg

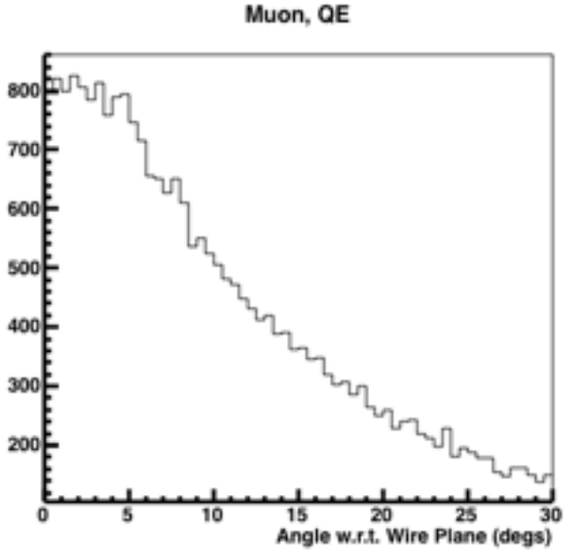
For g > 2p we want the conversion to be outside box

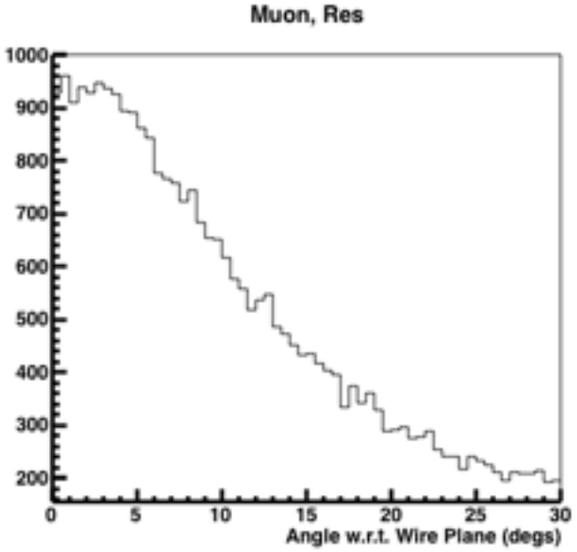
Lepton Angle with wire plane parallel

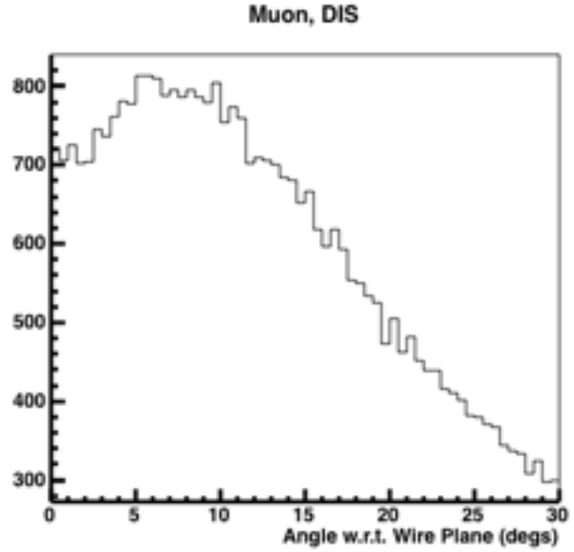












This is all signal. Question will be if we should reject signal events that may be background ?

Solutions ?

- Need to get better estimates of the problem from generator level simulations.

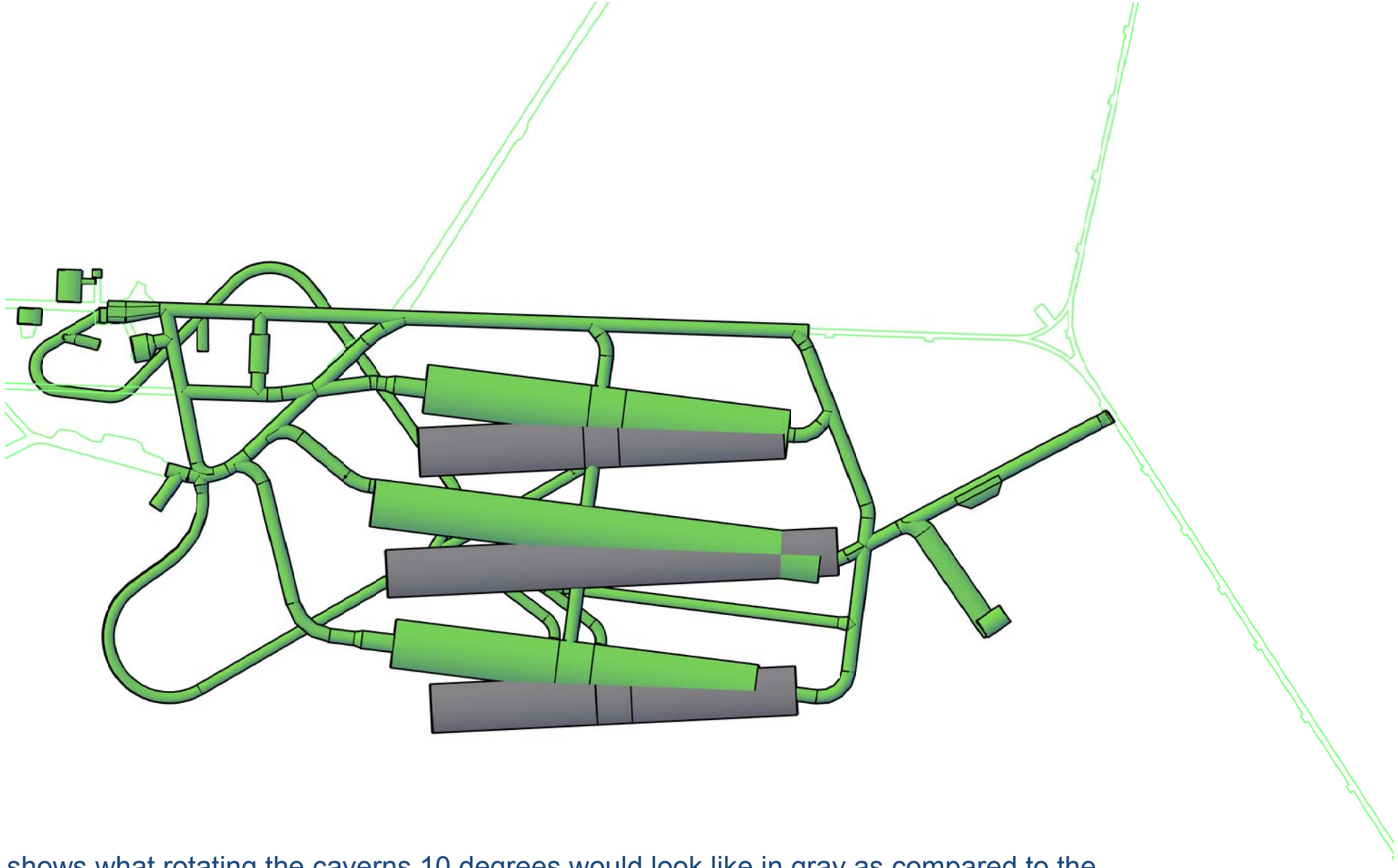
- Cannot eliminate the problem and so try to reduce it for the golden events only.

- Golden events have forward-going single leptons or showers with low multiplicity.

  - Put an angle between beam and vertical plane.

  - Either tilt the plane or rotate the cavern.

  - Adjust the collection field as a function of height ?



cartoon shows what rotating the caverns 10 degrees would look like in gray as compared to the current layout in green. Aside from the obvious need to redesign all accesses, a few comments:

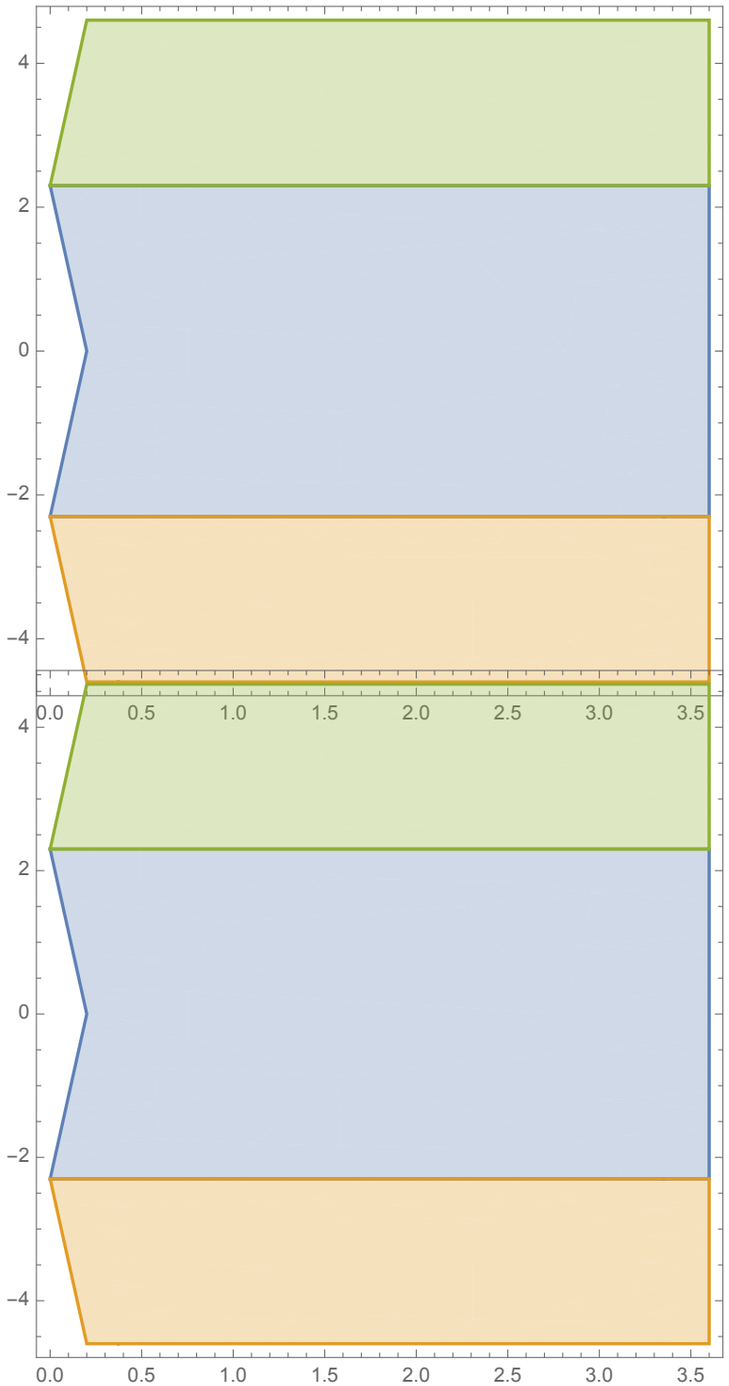
The west end of the south cavern moves into a less known rock mass (outside of the area where we drilled)
2. The distance into the south cavern increases, increasing cost

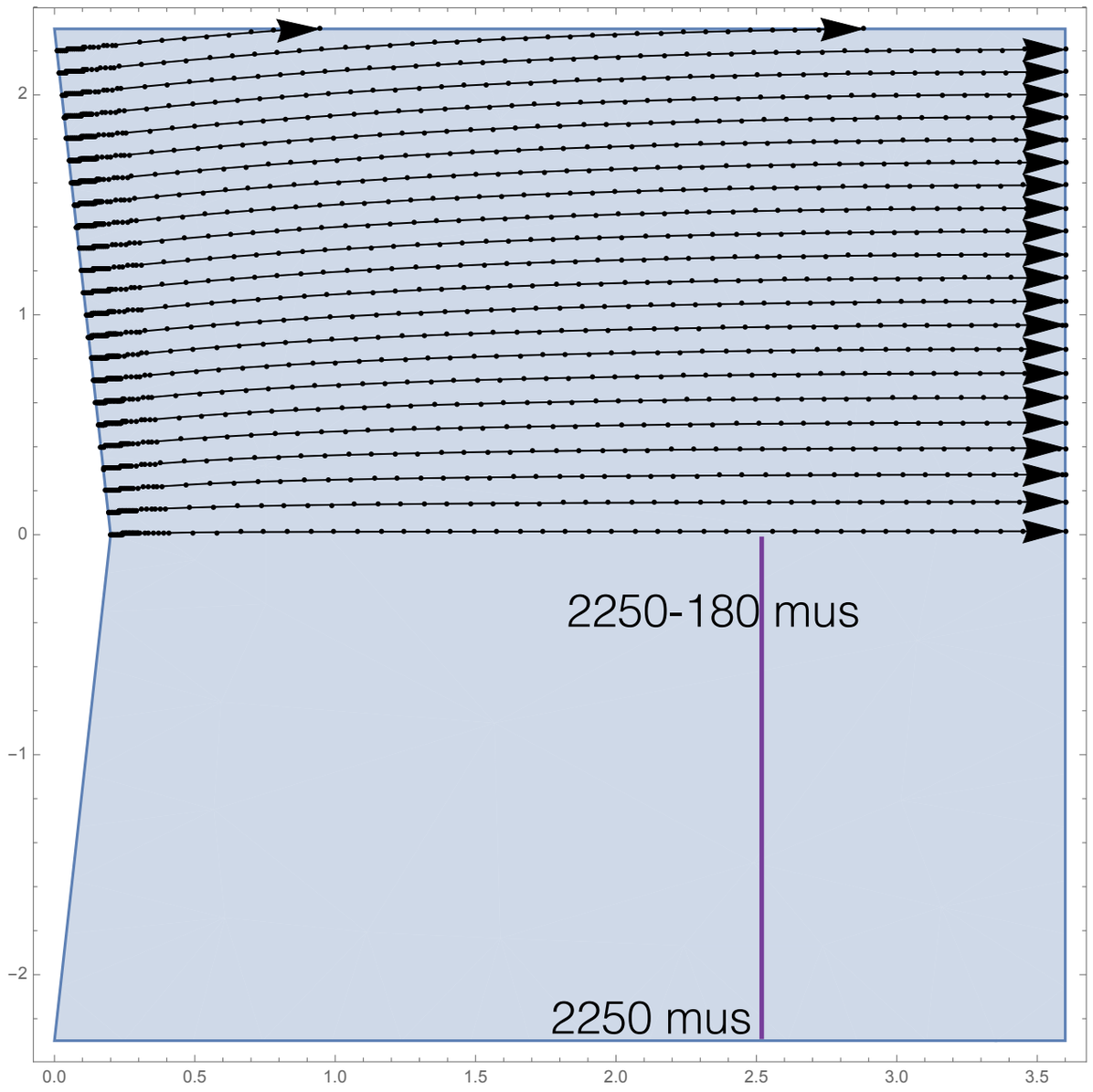
3. this might be slightly favorable geotechnically based on foliation orientation.

4. The turning radius coming into both ends would be slightly easier to achieve, primarily because the west end gets further away, giving more space to turn.

appears to be technically feasible.

How about APA angle ?





Issues and priorities

- Will calibration become more difficult ? Yes ?
- Does geometry of the APA in the corners need to be changed to parallelogram ?
- There will be issues with transparency condition and the field inside has to be raised to match the greater field.
- Recombination will be different in different regions of the detector causing charge and light emission calibration to vary.
- Track length will depend on the drift time. It is not a large effect.
- The region of ambiguity will be changed to another tilted region.
- The reconstruction will become more complicated for complex events.